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sons were given each of the following ten concrete and ten abstract words, and were required to name a suggested idea as quickly as possible; viz., *house, tree, ship, chair, clock, bird, shoe, hat, child, hand, and time, courage, form, virtue, art, love, strength, part, beauty, number*. Of the 4,650 "concrete" words, the ten words most frequently suggested by the ten given words form no less than 1,210, or more than one in every four. Two hundred and nineteen (or nearly one-half) responded with *finger* to the word *hand*, and 212 responded with *leaf* to the word *tree*: of the 4,650 words associated with the ten abstract words, the ten most frequent associations amount to 760 occurrences, or one in six; the most frequent associations being *good* or *goodness* with *virtue* (127 times), and *painting* with *art* (115 times).

An analysis of the associating processes here involved shows that in part they harmonize with the ordinary laws of association, but in part necessitate an extension of their interpretation. Dr. Cattell, regarding *contrast* as a variety of *similarity*, makes the latter and *contiguity in space and time* the two fundamental types of association. The latter associations are given us ready-made by sensation, and so may be termed objective or outer associations, while *similarity* may be displaced by *logical* associations. The *objective* are subdivided into *co-existence* and *succession*; the *co-existence*, into *co-ordination, whole to part, and part to whole*; the *succession*, into *forwards and backwards*. Again, the *logical* are either cases of *specification* or *causation*. The former, again, are either cases of *correlation, specialization, or generalization*; the latter, *final or efficient*. These classes are not natural kinds, nor does every association fall unambiguously into one class; but they call attention to real classes, and serve as a starting-point for further investigation. Associations occur that only by straining fall into any of the classes, associations by sounds of words (alliteration, rhyming) being an important example of these. From the tables printed in their essay, the authors conclude that with concrete nouns the link is "not quite as often supplied by thought as by sensation." *Whole to part* and *specialization* are very much more frequently used than *part to whole* and *generalization*. A comparison of the associations made by the writers and two other professional persons with those made by the pupils of several schools shows that "logical and verbal associations are favored by the first four observers, who teach and write. With the students, *whole to part* is the favorite category: they seem to visualize the object and name some part of it. . . . The largest proportion of logical associations was made by E and C, who are engaged in abstract studies." The word itself often suggests the special kind of association. Thus, "*tree* and *hand* are natural objects which are easily pictured, and have parts (leaves and fingers respectively) readily named. With *child*, on the other hand, specialization was the favorite category. Final cause was the largest class in the case of *clock*, a thing made and used for the special purpose of measuring time. Conversely, *time* often suggested the means of its measurement. Of the other abstract nouns, *art* and *number* were commonly specialized, while *courage* and *love* most frequently suggested a similar or contrasted idea."

In all such experiments the subject himself, by going over his experience just after the association, can recover the lost links which the mere statement of a word and its association would neglect. A few very suggestive appendices, founded upon such introspections, are given, that show how very complicated the associative process may be, and how very cautiously one must proceed in the discussion of them. However, these uncertainties do not seriously vitiate the value of experimental studies, and it is only by such studies that a practical insight into our mental processes can be gained. The ease with which association studies can be made should lead one to expect many valuable contributions in the near future.

THE MENTAL POWERS OF THE CHIMPANZEE. — The female chimpanzee in the Zoological Gardens at London, says *Nature*, has recently been made the subject of experiments by Dr. G. J. Romanes, that shed interesting light upon animal psychology. The general intelligence of the creature is very high. She understands a great many words, is ingenious in her play, and gives expression to her feelings in a variety of ways. If, instead of being constantly

exposed to the distracting influences of an inquisitive public, she were carefully reared, Dr. Romanes suggests that a higher degree of mental development might be expected. The experiments began by asking the chimpanzee to hand out one, two, or three straws from her cage. If the wrong number of straws was given, they were refused; but, when the action was correct, she was rewarded with a piece of fruit. The straws were taken one by one, and held in the mouth until the requisite number was gathered. She soon learned to associate these three names with the number of straws, and unfailingly gave the right number. Then *four*, and later *five*, was added to her vocabulary. Her keeper has attempted to teach the chimpanzee to count up to ten, but with only partial success. She rarely mistakes numbers up to five, and, when asked for seven, eight, nine, or ten, understands that this means "more than five;" but the accuracy of her count does not extend further than this. Dr. Romanes thinks it possible that the creature's patience may be exhausted in these high numbers, since she has to collect the straws one by one. As evidence of this, the creature has been observed to double a straw and offer it as two, thus showing a knowledge of multiplication. The mechanism of this process is hardly that of notation, but simply the appreciation of sense-impressions such as we see in a child and in savage people. Tribes to whom "more than five" is ascribed in an indefinite "many" have been observed. Dr. Romanes has also attempted to teach the chimpanzee the names of colors by holding out two straws of different colors, and requiring her to select the color named. She learned to distinguish the white straw from any other color, but never went further. Dr. Romanes sees no reason why this distinction should be easier than any other, and so regards the failure as probably due to color-blindness.

NOTES AND NEWS.

LOCOMOTIVE engineers are inclined, it is said, to obesity.

— Gum-chewers' paralysis is the latest form of professional neurosis recorded in medical literature.

— The chemists of the United States Agricultural Department are about to begin the work of investigating the different artificial foods and infant foods now on the market.

— The will of John W. McCoy, who died in Baltimore recently, contains a bequest of \$100,000 to the Johns Hopkins University. He also gives his library to this institution.

— The following appointments are announced at Clark University: Professor Arthur Michael of Tufts College, professor of chemistry; Professor J. Playfair McMurrich of Haverford College, docent in biology; Dr. Franz Boas, docent of the University of Berlin, docent in anthropology; B. C. Burt of Michigan University, docent in historical psychology; Professor Alfred Cook of Bryn Mawr College, docent in psychology; Dr. Arthur McDonald, docent in psychology; Professor Herman C. Bumpus of Olivet College, Michigan, fellow in biology.

— The English Silk Association is arranging to hold in London, next spring, an exhibition of the silk manufactures in the United Kingdom and Ireland. In order to place before the public the capabilities of the home industry for supplying its requirements, it has been decided that the exhibition should contain specimens of various branches, consisting, among others, of broad and narrow silk fabrics, including poplins, etc.; also lace, embroidery, silk hosiery, costumes, fans, trimmings, sewing and embroidery silks, twists, cords, etc.; thrown silks, Indian and British colonial raw silks, etc.; exhibits illustrative of the growth of silk, of the processes of manufacture, and of the printing, dyeing, and finishing of silk; various silk handicrafts in operation; industrial and decorative design as applied to silk fabrics.

— The recently published statistics of criminality in Germany confirm once more a fact brought out in earlier reports. For many years the character of criminal acts in that country has been undergoing a radical change: while those against property have shown a constant decrease in number, the number of crimes against life has as constantly increased. Some think they can trace a connection between an increase in the crimes against life and the increase in the use of alcoholic drinks, the greatest increase

being in Bavaria and in certain portions of Prussia where the alcohol habit has shown the greatest increase.

— Dr. Brown-Sequard is an American. His father, Capt. Edward Brown, of the American navy, was a Philadelphian, and married a French woman on the Island of Mauritius, named Sequard. He and his descendants took the name of Brown-Sequard. The distinguished scientist was the eldest child. He was educated in France, but was afterwards a professor in Harvard, and practised medicine in New York for some years after 1873. He married twice, his first wife being Miss Fletcher of Boston, a relative of Daniel Webster.

— Col. Thuillier's report on the progress of the surveys of India for the past year shows that the party employed on the trigonometrical surveys has completed the 370 miles remaining of the secondary triangulation along the east coast of India, as given in a recent number of *Engineering*. The secondary triangulation was also carried out for an aggregate length of 270 miles by parties employed in Beloochistan, as a basis for topographical surveys in that region. The work of the geodetic party comprised the measurement of seven arcs of longitude in southern India; and the tidal survey party continued its observations with self-registering tide-gauges at several stations along the coast, where tidal observatories are established, and connected with the operations of spirit-levelling. Geographical surveys have been carried out vigorously in upper Burmah, nearly 21,000 square miles having been surveyed and mapped on a half-inch scale. Reconnaissance along the Nepal boundary has supplied a rough basis for a more accurate and detailed survey of the northern frontier when an opportunity offers. Interesting additional information regarding Bhootan and Tibet has been obtained from the adventurous travels of native explorers, trained and sent thither by the department. Of the new maps, 4,062 were published during the year, and heavy demands continue to be made for transfrontier maps, and maps of upper Burmah. The photographic and lithographic offices show the large output of 1,203,861 copies during the year, including high-class illustrations for archaeological and other reports.

— M. Vénukoff, writing to the *Scottish Geographical Magazine*, says, "M. Grum-Grjimaïlo has commenced his journey in Central Asia, starting from Vernoi. His first letter, dated from Jarkent, on the Russo-Chinese frontier in Dzungaria, appeared in the Russian journal *Novosti* for July 6, 1889. It informs us that the season of spring was this year late in Dzungaria, and that the lower limit of snows on the Ala Tau Mountains reached in the month of May to an elevation above the sea-level of 7,874 feet, which was very low for that season of the year in the latitude of 43° north, and under the brilliant sky of Central Asia. The Ili and all other rivers of the region were greatly increased by the melting of the snows in June. M. Grum-Grjimaïlo will continue his journey in the Chinese provinces adjoining the Thian Shan; but it is expected that the Chinese authorities will place obstacles in his way, from the fact of his being unprovided with a passport from the Tsung-li-yamen of Peking. But if he succeeds, he will establish a precedent for all future explorers. I should add, that quite recently Jarkent has suffered greatly from a violent earthquake, but it appears that this occurred after M. Grjimaïlo's departure. Col. Pevtsov reached Yarkhand towards the end of May. At about the same time, Capt. Grombtchevsky was on the Pamir, in the neighborhood of Daraout-Kourgan, whence he was to have made his way to Chougnan; but, the latter country having been again occupied by the Afghans, I do not know whether the explorer will venture to enter it." The ethnographical map prepared by M. Vénukoff in 1883, he has now brought up to date, showing the distribution of the populations in the interesting and important district of Vladivostok. The region represented is, roughly, bounded on the west by Manchuria, on the north by latitude 45° north, and a little beyond, on the east, by longitude 135° east, and on the south by the sea. Within this territory there was, in 1888, a population numbering 55,600, of whom 35,000 were Russians, 10,000 Coreans, 9,500 Chinese, 500 Japanese, 500 Goldis and Orotchis, and 100 Europeans. Among the Chinese there were nearly 1,000 nomads; the Goldis and Orotchis are also nearly all nomads (hunters and fishers). The Europeans and the Japanese inhabit Vladivostok. The Coreans

are all sedentary, and they inhabit the large villages; while the Chinese are dispersed about the country, noticeably in communities (farms) settled along the eastern river-courses. The principal centre of population is of course Vladivostok (13,000 inhabitants); then come Nicolskoé, Novo-Kief, and Kamen-Rybolov. There are in the Russian villages 9 *stanitzas* occupied by 2,877 Cossacks, whose duty it is to guard the frontier between Lake Hankai and the mouth of the Toumen-oula.

— A French military writer writes in the *République Française* as follows on the subject of melinite. His remarks are interesting but should be accepted with a considerable amount of reserve. "Our shells for field artillery, as well as those for our forts and siege-guns, are charged with melinite. What melinite is, we do not know, and if we knew we should be very careful not to tell. Both the Italians and the Germans have sent spies to discover the secret, and to offer money for even the smallest fragment, but they have all been captured. All that can be said is, that, according to a treatise published in 1882, melinite is composed of melted picric acid. But in the interval our artillerists have perfected the discovery of M. Turpin. They have made melinite a tractable product. The effects of this explosive were fully demonstrated at some experiments at the Fort of Malmaison in 1886. Melinite is so safe, that in three years only one accident has occurred, that at the arsenal of Belfort. On the other hand, a hundred accidents have occurred from gelatine alone in thirty years. There has never been an accident in drawing the charges, nor one from bursting in the gun. As much cannot be said for roburite, hellofite, or the other substances employed by foreign States. What will become of a fortification in face of this redoubtable agent? Some think and say they are doomed; others, like Gen. Brialmont, recommend the use of armored circular forts. It is said that the shell will glance off these without doing any damage; but experiments at Chalons have shown that turrets enjoy no immunity against a close and continuous fire."

— Those living in a locality in which the mosquitoes are troublesome, says the *Annals of Hygiene*, may make a trial of the following recipe for expelling these pests from the house: take a piece of gum-camphor, in size about the third of a hen's egg, and slowly evaporate it by holding it in a shovel or tin vessel over a lamp, taking care that it does not ignite. The smoke will soon fill the room and expel the mosquitoes, and it is said they will not return, even though the windows should be left open all night.

— The following resolutions were adopted by the international congress on hypnotism held in Paris last month: 1. Public exhibitions of hypnotism or magnetism should be forbidden by government; 2. The use of hypnotism as a therapeutic agent should be restricted to practising physicians; 3. It is to be hoped that the method and practice of hypnotism will be included in the medical education of students.

— Recognizing the difficulty that is experienced in keeping fire-pails constantly full, an American inventor has proposed to cover the pail with an air-tight sheet of tinfoil, which, while preventing the contents from evaporating, can, when wanted, be easily broken through by the hand. In order to anticipate the almost equal difficulties that may arise from the freezing of the contents, brine, or some similar liquid, may be used for filling the pails, in place of water.

— Sibley College is to have a tremendous class this year. The college will be crowded by 350 or 400 students where they were only really desirous of handling 200, the limit set four years ago as the maximum number that they were likely to find satisfactory room for. Cornell University will have a class somewhere between 425 and 450, and a total in all branches and classes of about 1,300, perhaps 1,400. They can again boast the largest freshman class entering any American university.

— It is reported from Japan (*Nature*, Sept. 12), that Viscount Ennomoto, the new minister of education, is devoting special attention to the introduction of technical education into the primary schools of the empire, and that he has turned to Italy as a model. His scheme is to include technical education in the curriculum of the preparatory schools, and to give children technical training from the outset.

— At the July meeting of the Anthropological Society of Bombay, Mr. Kitts of the Indian Civil Service read a paper on the early history of northern India, in which the theory recently put forward by Mr. Hewitt, on the early history of India, was stated and discussed. The theory of Mr. Hewitt, as stated in *Nature*, is briefly this: that the first immigrants who settled in India, and have left traces surviving, were the so-called Kolarian races, who came from the north-east; and that their descendants, to the number of ten millions or thereabouts, are still occupants of northern India. The Kolarians were succeeded and conquered by the Dravidians, who came from the north-west, and developed in India a very high state of civilization, both social and political. Large estates belonged to single owners, such as the *talukdari* tenures in northern India, and the *zemindari* and *patidari* tenures in southern India. "In short," says Mr. Hewitt, "it was the Dravidians who founded and consolidated the present land-revenue system of India." The Dravidians also organized the *punchayet* and *chowkidar* system of village government, which has survived to the present day. All the manual arts and industries practised in the India of to-day were known to and practised by the Dravidians. The Aryans, migrating into a land occupied as India then was by the Dravidians, with a strongly organized system of government, found great difficulty in obtaining a foothold, and, even when they had secured a tract of country in the north-west for themselves, did not obtain supremacy over the rest of India by force of arms. The agents of their subsequent advance were three, — religion, commerce, and military ability. Friendly alliances were concluded between the new-comers and the snake races of the Dravidians. The Aryans admitted the noble races of the Dravidians to be of royal blood, and accepted Siva or Lingam worship as not dishonoring to their religion. The Dravidians, thus recognized as of noble blood, were the ancestors of the modern Rajpoots and the Kshatriya caste. Intellectually the Aryans were far superior to the Dravidians, and the Aryan tongue was accordingly adopted as the *lingua franca* for commercial purposes. So, too, the Aryan became a necessary element in every court and in every commercial enterprise, and from this time forward (about six centuries B.C.) their supremacy was assured.

— According to *Nature*, Dr. Rudolph Koenig, the well-known constructor of standard acoustical apparatus in Paris, has just made a discovery of extreme importance in the theory of music, the details of which he will expound at the forthcoming meeting of the Naturforscher at Heidelberg. This is an extension of Helmholtz's theory of timbre to certain cases not represented in the elementary mathematical theory, and corresponding to the actual case of the timbres of certain musical instruments. The paper is certain to give rise to discussion, and will be of interest to musicians, who have never, as is notorious, taken kindly to Helmholtz's theory in its original form.

— Mr. Gustave Guttenberg, formerly of Erie, Penn., who is conducting the Agassiz course of mineralogy, has accepted the position of teacher of biology in the Central High School at Pittsburgh, Penn., and desires his correspondents to take notice of the change of his address.

— The following topics have been selected for consideration at the seventeenth annual meeting of the American Public Health Association, Brooklyn, to be held Oct. 22–25: "The Causes and Prevention of Infant Mortality;" "Railway Sanitation," — (a) "Heating and Ventilation of Railway Passenger-Coaches," (b) "Water-Supply, Water-Closets, etc.," (c) "Carrying Passengers Infected with Communicable Diseases;" "Steamship Sanitation;" "Methods of Scientific Cooking;" "Yellow-Fever," — (a) "The Unprotected Avenues through which Yellow-Fever is Liable to be brought into the United States," (b) "The Sanitary Requirements necessary to render a Town or City Proof against an Epidemic of Yellow-Fever," (c) "The Course to be taken by Local Health Authorities upon the Outbreak of Yellow-Fever;" "The Prevention and Restriction of Tuberculosis in Man;" "Methods of Prevention of Diphtheria, with Results of such Methods;" "How far should Health Authorities be permitted to apply known Preventive Measures for the Control of Diphtheria;" "Compulsory Vaccina-

tion;" and "Sanitation of Asylums, Prisons, Jails, and other Eleemosynary Institutions." Addresses of welcome will be delivered by Hon. Alfred C. Chapin, mayor, on behalf of the city, and by Alexander Hutchins, M.D., on behalf of the medical profession.

— Dr. George H. Cook, the New Jersey State geologist, and vice-president of Rutgers College, died Sept. 22, at New Brunswick, of heart-failure. Dr. Cook was taken ill Saturday noon, but his illness was not considered at all serious, and his death was totally unexpected. His work as State geologist has been varied and of great importance. The topographical maps of the State which have been published under his supervision have been among the best of any published by the different States. The last of the series was recently issued, and Dr. Cook was at the time of his death engaged on his final report. Two volumes had been prepared, the latter now being in print. He was seventy-two years of age, and leaves a widow and two children, — one son and one daughter.

— Among the recent scientific missions undertaken by order of the French Government, says *Nature*, are one by Professor Viault of Bordeaux, in the tablelands of Peru, Ecuador, and Bolivia, to continue the investigations of the late M. Paul Bert into rarefied air; one by M. de Coubertin, secretary of the committee for the encouragement of physical exercises in education in the United States and Canada, to visit the universities and colleges, to study the working of the various athletic associations frequented by the young people of these countries; one by M. Jacques de Morgan, mining engineer, to explore those parts of Asia Minor lying between the south of the Caspian Sea, Armenia, the Gulf of Alexandria, and Anti-Taurus (this mission will occupy two years and three months); and one by M. Candelier, to Colombia, to make ethnographical researches and collections for the State.

— Exactly a century ago — namely, in 1789 — Klaproth succeeded in isolating from a dark-colored mineral known as pitchblende a yellow oxide, which, after carefully testing, he pronounced to be the oxide of a new metal. To this metallic substance he gave the name of "uranium," so calling it after the planet Uranus, then recently discovered by Herschel; and it was at once classed among the rare metals, and still remains so. Its rarity is indicated by its market price, which is about \$12,000 per ton. There are several oxides of this metal; but the best known and most important is the sesquioxide, which forms a number of beautiful yellow salts. This oxide is largely employed for imparting delicate golden and greenish yellow tints to glass, while the protoxide is much used in producing the costly black porcelain. Uranium is also found to be useful in certain photographic processes as a substitute for the chloride of gold; but its rarity and consequent high price have hitherto caused its application to be very limited, although there are uses other than those already named to which it could be put if it were less scarce and less costly. It is found in Cornwall, Saxony, and Bohemia; but up to the present time it has only been met with in isolated pockets and patches. The centenary of its discovery by Klaproth has, however, according to the *London Times*, been marked by the finding of a continuous lode at the Union Mine, Grampound Road, Cornwall, which is believed to be the only known lode in the world. This discovery is regarded as unique in the history of the metal; for the lode is what is known as a true fissure-vein, and the ore is found to contain an average of twelve per cent of the pure metal, the assays going up as high as thirty per cent in some parts of the lode. Several tons of the ore have already been raised and sold, fetching high prices. The lode traverses the mine from north to south, and the uranium occurs in it chiefly as a sesquioxide. It is anticipated that the present discovery will enable two important applications of the metal to be followed up. The first is as a substitute for gold in electroplated ware, inasmuch as with platinum and copper it forms two beautiful alloys, each having the appearance of gold, and the former also resisting the action of acids. The second application is in connection with electric installations, where its usefulness consists in its high electrical resistance. The mineral deposits generally at the Union Mine are of an exceptional character, comprising, in addition to uranium, magnetic iron, silver, lead, tin, copper, ochre, and umber.